No. 791,660. PATENTED JUNE 6, 1905.

G. WALZEL.

REDUCTION FURNACE.

APPLICATION FILED AUG. 12, 1904.

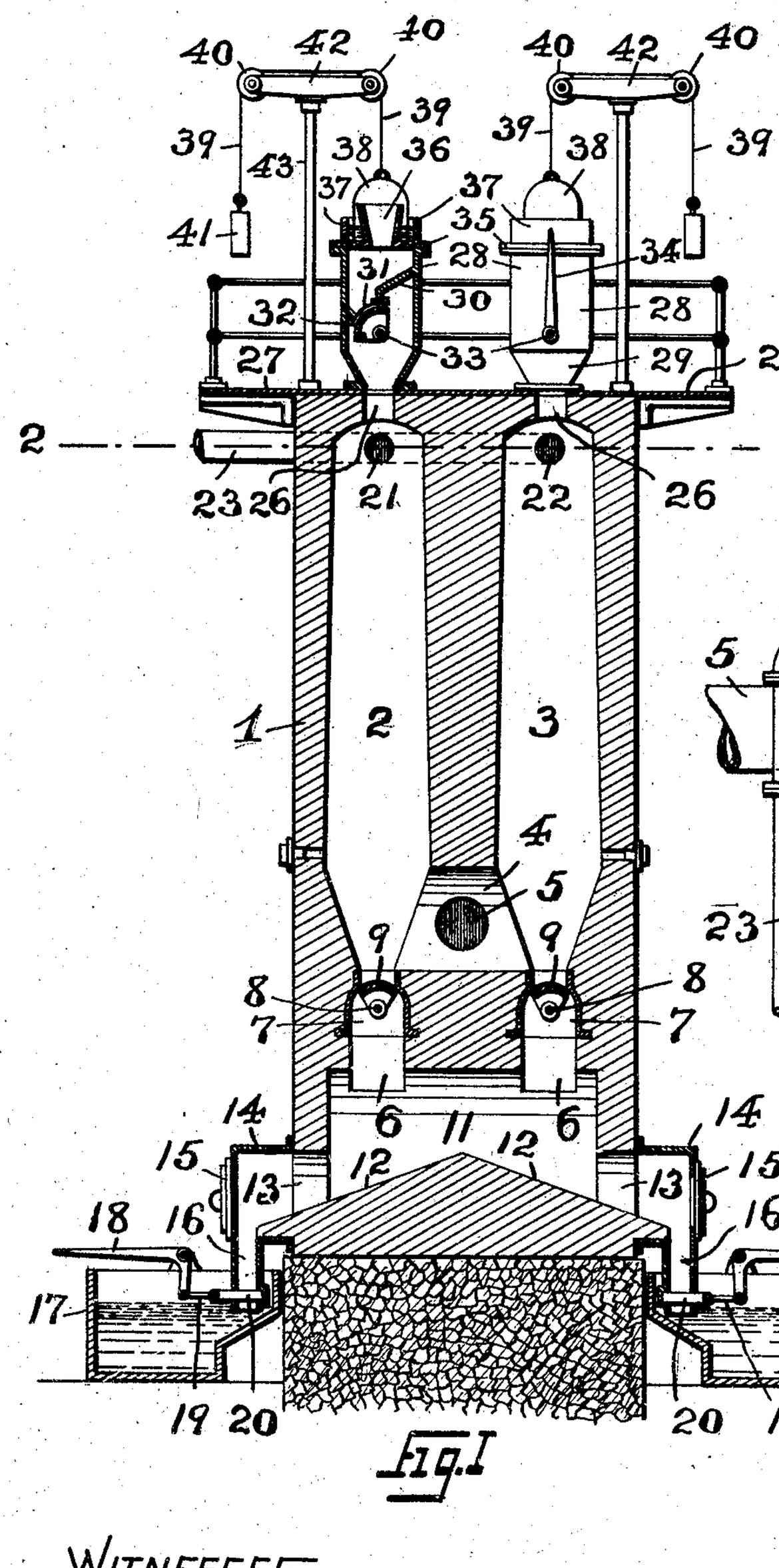

Fig. I

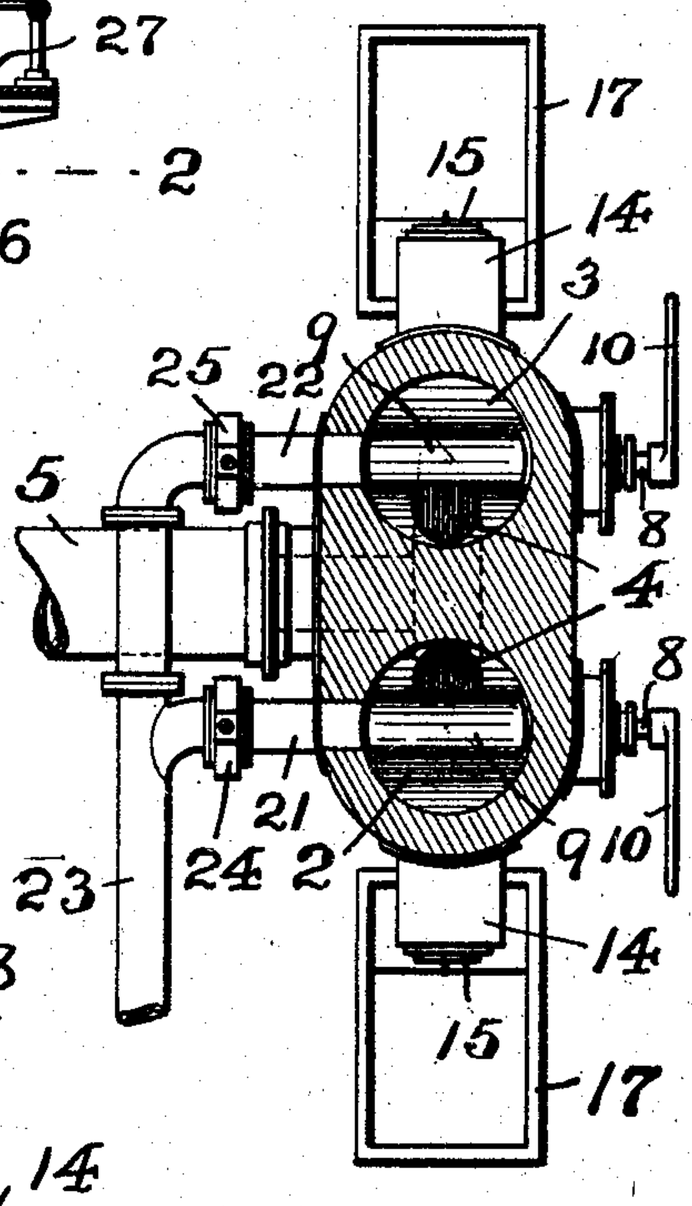

Fig. II

WITNESSES

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No. 791,660. Patented June 6, 1905.

UNITED STATES PATENT OFFICE.

GREGOR WALZEL, OF NEWARK, NEW JERSEY, ASSIGNOR TO EDWARD ZUSI, OF NEWARK, NEW JERSEY.

REDUCTION-FURNACE.

SPECIFICATION forming part of Letters Patent No. 791,660, dated June 6, 1905.

Application filed August 12, 1904. Serial No. 220,482.

To all whom it may concern:

Be it known that I, GREGOR WALZEL, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Reduction-Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to characters of reference marked thereon, which form a part of this specification.

My present invention has reference to improvements generally in reducing-furnaces; and the invention has for its principal object to provide a reducing-furnace for the reduction of limestone or for the purpose of reducing iron ore to produce iron sponge, such furnace being provided with water-sealed charging and emptying devices.

A further object of this invention is to provide a double-shaft furnace of such arrangement and construction that the reducing-gases which are carried into the furnace will in one shaft reduce only the material contained in said shaft through which the gases are allowed to circulate, while by radiation the heat from the active shaft passes into the inactive shaft and the material in said inactive shaft becomes preheated, the main purpose being to provide a double-shaft reducing-furnace the shafts of which are used alternately in first preheating and reducing the material, so as to insure a continuous process of reduction.

A still further object of this invention is to provide a double-shaft reducing-furnace, each shaft being provided with a water-sealed charging device at the top and at the bottom with a water-sealed emptying device.

As stated, the reducing-furnace may be used for the reduction of iron ore to produce iron sponge; but the furnace is preferably for the purpose of reducing limestone by the introduction of hot air with steam or hot carbon dioxid with steam, and especially for the purpose of producing carbonic acid, as set forth in my previous application for Letters Patent filed August 10, 1904, Serial No. 220,186.

My invention consists in the novel reduction-furnace hereinafter fully specified; and, furthermore, this invention consists in the novel arrangements and combinations of devices and parts, as well as in the details of the construction of the same, all of which will be more fully described in the following specification and then finally embodied in the clauses of the claim, which are appended to and form an essential part of the same.

The invention is clearly illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of one form of reducing-furnace embodying the principles of this invention; and Fig. 2 is a horizontal section of the same, said section being represented as taken on line 2 2 in said Fig. 1.

Similar characters of reference are employed in the said drawings to indicate corresponding parts.

Referring to the said drawings, the reference character 1 indicates a complete furnace embodying the principles of my present invention, the same being provided in its interior with two shafts 2 and 3, which are connected at their lower portions by means of a duct 4, into which extends from the outside of the furnace a gas-conveying duct or pipe 5 for carrying the gases into either of the said shafts 2 and 3 alternately, in the manner and for the purposes set forth in my previous application for Letters Patent, filed August 10, 1904, Serial No: 220,186. Each shaft 2 and 3 communicates at its lowest point with a duct or passage-way 6, provided with a suitably-constructed frame 7 or similar device, and each frame is formed with bearings for a rock-shaft 8, having a closing plate or gate 9 and manipulated by means of a lever or handle 10 upon the outer side of the furnace. Each duct or passage-way 6 leads to a main delivery-chamber 11 in the bottom of the furnace, said chamber being provided with a bottom 12, which tapers downwardly from its center to the opposite sides of the furnace, that the

charges of calcined limestone or other material when discharged into the chamber 11 from either shaft 2 or 3 will pass down the downwardly-tapering surfaces of the bottom to the openings 13 in the opposite sides of the furnace. Placed against each opening 13 is a hood 14 or other suitably-constructed device, as a box, which may be provided with a door 15 and a discharging duct or outlet 16. Each duct or outlet 16 has its mouth arranged beneath the surface of a body of water contained in suitably-constructed tanks or receptacles 17 of any desired size and capacity, substantially as shown. Connected with each tank or receptacle 17 is a bell-crank 18 and link 19 for opening and closing a slide or gate 20, arranged in each duct or outlet 16 of the respective hoods or boxes 14. Thus it will be evident that when there is a charge of calcined limestone in the hoods or boxes 14 the slides or gates 20 can be opened and the limestone dropped into the water to be slaked therein. At the same time when the material in the shafts is undergoing the process of reduction it will be evident that a suitable water seal is provided at the bottom of the furnace to prevent any admission of atmospheric air. Of course it will be understood that with the process of reducing iron ore to produce iron sponge these water tanks or receptacles 17 are not necessary and in that case are dispensed with, the hoods or boxes 14 then being made without such discharging ducts or outlets 16, in which case the material, as the iron sponge, is removed through the openings in the front of the said hoods or boxes. Connected with an opening in the upper portion of the respective shafts 2 and 3 are pipes or ducts 21 and 22, which communicate with a main pipe or duct 23, leading to a suitable reservoir in which the carbon dioxid generated with the limestone-calcining process is collected and stored. The pipe or duct 21 is provided with a suitable valve or shut-off 24, and the pipe or duct 22 is provided with a suitable valve or shut-off 25, whereby communication between the said main pipe or duct 23 and either of said shafts 2 and 3 may be made at will, as may be desired. Each shaft 2 and 3 is made in its upper portion with an opening 26, and upon the top of said furnace there may be a suitable platform, as 27, having openings which correspond to the openings 26 of the respective shafts 2 and 3. Suitably secured upon the said platform and directly over each opening 26 are a pair of charging devices 28.

Each charging device 28, as will be seen from an inspection of Fig. 1 of the drawings, consists, essentially, of a cylindrical body having an open and hopper-shaped bottom 29, and within each body is an inclined partition 30, provided with an opening 31, each opening being closed by means of a suitably-constructed gate 32, secured upon a rock-shaft 33, said shafts being rotatably arranged in bearings in the said cylindrical bodies and being manipulated from a lever or arm 34, secured upon the end of each shaft. The upper and open part of each cylindrical body is provided with a cover 35, having an opening, above which extends a feed device or hopper 36, substantially as shown. Each cover 35 is also made with an upwardly-extending wall 37, providing a space between the inner surfaces of the wall and the outer surfaces of each feed device or hopper 36, which can be filled with water, as shown. Suitably arranged over each feed device or hopper, with its marginal edge portions extending into the water to provide a perfect water seal, is a bell-shaped cover or casing 38. That each bell-shaped cover or casing 38 may be raised above the upper open portion of each hopper, a flexible connection 39, passing, preferably, over a pair of grooved wheels or sheaves 40, has its end attached to the bell-shaped cover or casing 38 and has secured to its other end a counter weight or balance 41 to provide ease of manipulation. The said wheels or sheaves are suitably secured to cross-arms 42 upon standards 43 upon the platform 27, substantially in the manner illustrated in said Fig. 1 of the drawings. By this arrangement of bell-shaped covers or casings 38 and the water-containing covers 35 it will be clearly seen that each charging device or cylinder 28 is perfectly water-sealed to prevent any atmospheric air from passing into the furnace during the reducing processes.

The double-shaft furnace hereinabove described is of a simple construction and is very efficient in its operation, the two shafts being alternately put in operation, whereby the continuity of the reducing process is insured, and while one shaft is being operated the other shaft is being preheated from the heat of the other shaft, thus also rendering the method and process of reduction more economic than with a single-shaft furnace.

Of course I am aware that changes may be made in the arrangements and combinations of the devices and parts, as well as in the details of the construction of the same, without departing from the scope of this invention. Hence I do not limit my invention to the exact arrangements and combinations of the devices and parts as described in the foregoing specification and as illustrated in the accompanying drawings, nor do I confine myself to the exact details of the construction of the said parts.

Having thus described my invention, what I claim is—

1. A limestone-reducing furnace, comprising a single stack and a multiplicity of internally-disposed shafts, a means of communication between the lower portions of said shafts, a single gas-conveying means connected with

said means of communication between the said shafts, a charging device arranged upon the top of each shaft, an independent outlet at the bottom of each shaft, and an emptying device connected with the outlet of each shaft, substantially as and for the purposes set forth.

2. A limestone-reducing furnace, comprising a single stack and a multiplicity of internally-disposed shafts, a means of communication between the lower portions of said shafts, a single gas-conveying means connected with said means of communication between the said shafts, a water-sealed charging device arranged upon the top of each shaft, an independent outlet at the bottom of each shaft, and a water-sealed emptying device connected with the outlet of each shaft, substantially as and for the purposes set forth.

3. In a reducing-furnace, a multiplicity of shafts, a means of communication between said shafts, a main receiving-chamber having oppositely-placed discharge-openings, a means of communication between the bottom of each shaft with said main receiving-chamber, and a water-sealed hood or box connected with each discharge-opening of said main receiving-chamber, substantially as and for the purposes set forth.

4. In a reducing-furnace, a multiplicity of shafts, a means of communication between said shafts, a main receiving-chamber having oppositely-placed discharge-openings, a means of communication between the bottom of each shaft with said main receiving-chamber, a hood secured over each discharge-opening of said main receiving-chamber, a valved outlet-duct connected with each hood, and water-receptacles into which said ducts extend, substantially as and for the purposes set forth.

5. In a reducing-furnace, a multiplicity of shafts, a means of communication between said shafts, a main receiving-chamber having oppositely-placed discharge-openings, a means of communication between the bottom of each shaft with said main receiving-chamber, and a gate in said means of communication between said shafts and said main receiving-chamber, substantially as and for the purposes set forth.

6. In a reducing-furnace, a multiplicity of shafts, a means of communication between said shafts, a main receiving-chamber having oppositely-placed discharge-openings, a means of communication between the bottom of each shaft with said main receiving-chamber, a gate in said means of communication between said shafts and said main receiving-chamber, and a water-sealed hood or box connected with each discharge-opening of said main receiving-chamber, substantially as and for the purposes set forth.

7. In a reducing-furnace, a multiplicity of shafts, a means of communication between said shafts, a main receiving-chamber having oppositely-placed discharge-openings, a means of communication between the bottom of each shaft with said main receiving-chamber, a gate in said means of communication between said shafts and said main receiving-chamber, a hood secured over each discharge-opening of said main receiving-chamber, a valved outlet-duct connected with each hood, and water-receptacles into which said ducts extend, substantially as and for the purposes set forth.

8. The combination, with a reducing-furnace having a shaft provided with an opening in the top, of a water-sealed charging device over said opening, comprising a cylinder having an open and hopper-shaped bottom, a chambered cover and receiving-hopper on said cover, said cover being adapted to contain water, a bell-shaped cover over said hopper having its mouth extending into the water, and means for lifting said bell-shaped cover from said hopper, substantially as and for the purposes set forth.

9. The combination, with a reducing-furnace having a shaft provided with an opening in the top, of a water-sealed charging device over said opening, comprising a cylinder having an open and hopper-shaped bottom, a chambered cover and receiving-hopper on said cover, said cover being adapted to contain water, a bell-shaped cover over said hopper having its mouth extending into the water, and means for lifting said bell-shaped cover from said hopper, consisting of a standard and cross-arm, sheaves upon said arm, a flexible connection arranged over said sheaves, secured at one end to said bell-shaped cover, and a counterbalance at the other end of said flexible connection, substantially as and for the purposes set forth.

10. The combination, with a reducing-furnace having a shaft provided with an opening in the top, of a water-sealed charging device over said opening, comprising a cylinder having an open and hopper-shaped bottom, an inclined partition in said cylinder provided with a delivery-opening, a gate in said cylinder beneath the said opening, a chambered cover and receiving-hopper on said cover, said cover being adapted to contain water, a bell-shaped cover over said hopper having its mouth extending into the water, and means for lifting said bell-shaped cover from said hopper, substantially as and for the purposes set forth.

11. The combination, with a reducing-furnace having a shaft provided with an opening in the top, of a water-sealed charging device over said opening, comprising a cylinder having an open and hopper-shaped bottom, an inclined partition in said cylinder provided with a delivery-opening, a gate in said cylinder beneath the said opening, a chambered cover and receiving-hopper on said cover, said cover being adapted to contain water, a bell-shaped cover over said hopper having its mouth ex-

tending into the water, and means for lifting said bell-shaped cover from said hopper, consisting of a standard and cross-arm, sheaves upon said arm, a flexible connection arranged over said sheaves, secured at one end to said bell-shaped cover, and a counterbalance at the other end of said flexible connection, substantially as and for the purposes set forth.

In testimony that I claim the invention set forth above I have hereunto set my hand this 6th day of August, 1904.

GREGOR WALZEL.

Witnesses:
FREDK. C. FRAENTZEL,
GEO. D. RICHARDS.